



A Closer Look at Elementary Mathematics

Graduate and Alternative Route Elementary Programs

KEY FINDINGS: Just one percent of the 201 traditional graduate elementary programs cover the critical topics elementary teachers need including numbers and operations; algebra; geometry; and data and probability. This figure compares unfavorably with the coverage of undergraduate programs coverage that stands at 13 percent as of 2016. The systematically poor preparation of elementary teachers in mathematics may stand as one of the most staggering weaknesses in teacher preparation, contributing to the chronically low standing of American schoolchildren in mathematics internationally. The lack of appropriate content in this area may well be attributed to a false assumption that mathematics coursework aimed only at teachers would imply coursework that is too easy, in spite of clear guidance to the contrary by mathematicians, math associations such as NCTM and the practices of other nations.

Why teacher prep programs should have strong preparation in elementary mathematics

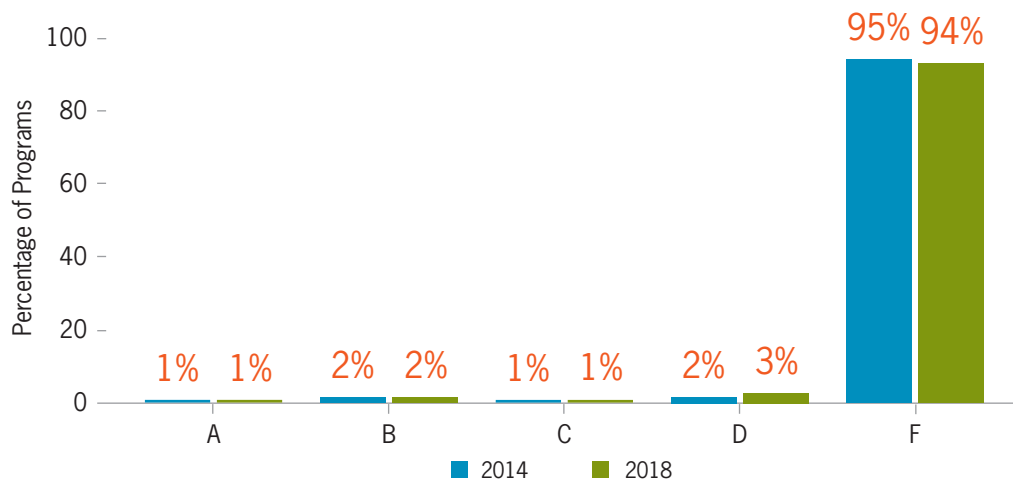
Teaching elementary children the fundamentals of arithmetic — dividing fractions, operations with signed numbers, or basic probability — requires a deep understanding of the underlying mathematics. For elementary teachers, it is simply not sufficient just to know rules such as “invert and multiply.” One must be able to explain why rules work, building upon the more fundamental whole number operations. To do so requires specialized mathematics coursework designed specifically for prospective elementary teachers. Such coursework cannot be simply a repeat of teachers’ own elementary mathematics lessons, but one that takes a deep, conceptual approach to the content. Typical college-level coursework (such as calculus) does not address this need.

To earn an A in elementary mathematics, a program must dedicate sufficient time to adequately cover the majority (≥ 75 percent) of essential math content. It should also require a methods course in teaching mathematics to elementary-aged children.

For more information about analysis and program grades, see the Methodology in brief and Understanding program grades sections below.

Percentage of graduate elementary programs and adequacy of coverage of the critical topics of elementary mathematics

(N=201 graduate elementary programs in 2018; N=167 graduate elementary programs in 2014)



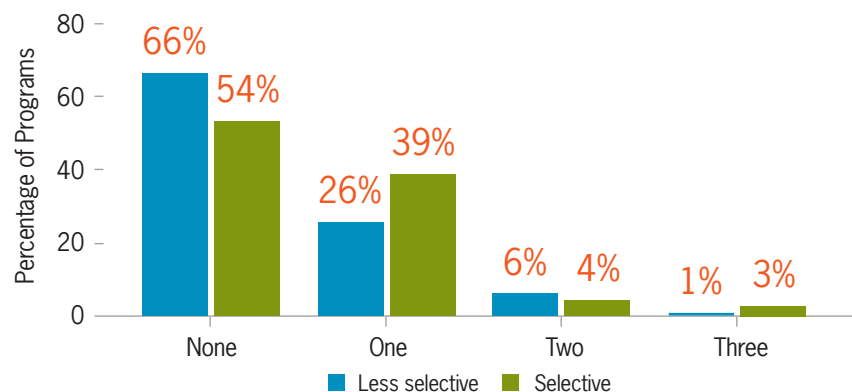
In an area yielding some of the lowest performance by programs, 94 percent of graduate elementary programs do not dedicate sufficient time to the necessary content.

Overall, there has been no change in our graduate elementary mathematics results between 2014 and 2018. Of the 167 graduate programs we evaluated in both releases, 96 percent earned the same grade.

We reviewed a limited sample of elementary alternative certification programs. Of the 28, 23 earned an A in elementary mathematics because they require an adequate test of elementary mathematics knowledge as a part of admissions, an option that any of the traditional graduate program could also pursue

Mathematics content coursework expectations explain these grades

(N=201 graduate elementary programs)



Almost two-thirds of all the graduate programs do not require a single course in the necessary content — even though mathematicians recommend three courses for candidates of average math ability and two courses for candidates who have a strong background in mathematics.

The best textbooks most used in graduate programs

Title	Author	Edition	Count
(Billstein) A Problem Solving Approach to Mathematics for Elementary School Teachers (thru 12th ed)	Billstein, R.; Libeskind, S.; Lott, J.W.	11	10
(Beckmann) Mathematics for Elementary Teachers (thru 4th ed)	Beckmann, S.	4	4

Methodology in brief

Mathematics professors and educators reviewed course descriptions, syllabi, and required textbooks in required math coursework. They looked to see if coursework covered conceptual understanding of these 12 essential elementary math topics and whether candidates get significant exposure to them:

Numbers & Operations Whole numbers	Algebra	Geometry	Data Analysis and Probability
<ul style="list-style-type: none"> Whole numbers Fractions and integers Decimals Estimating and rounding 	<ul style="list-style-type: none"> Constants and variables Equations Graphs and functions 	<ul style="list-style-type: none"> Measurement Basic concepts of plane geometry Polygons and circles Perimeter, area, volume 	<ul style="list-style-type: none"> Probability and data characteristics

To learn more about how we evaluate programs for elementary mathematics, please see our methodology.

For examples of model materials on this standard, please see the resources section.

Understanding program grades for Elementary Mathematics

- A+** The program addresses the vast majority of topics ($\geq 90\%$) in coursework equivalent to at least 8 semester credit hours (6 semester credit hours if the institution is selective). The program requires a methods course in teaching elementary mathematics.
- A** Programs address at least the majority (≥ 75 percent) of topics in coursework equivalent to at least 8 semester credit hours (6 semester credit hours if the institution is selective). The program requires a methods course in teaching elementary mathematics.
- B** Programs address at least the majority (≥ 75 percent) of topics but fall somewhat short on the time needed to cover the content, in a coursework equivalent to 6 or 7 semester credit hours (4 or 5 semester credit hours if the institution is selective).
- C** Programs address at least the majority (≥ 75 percent) of topics in but do not dedicate sufficient time to do so with coursework equivalent to no more than 4 semester credit hours.
- D** Programs address less than (≤ 75 percent) of topics and do not dedicate sufficient time to the content with coursework equivalent to at least 4 semester credit hours.
- F** Programs do not require any relevant course at all or require insufficient time with coursework equivalent to less than 4 semester credit hours.



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